



Climate change impacts and coastal livelihoods; an analysis of fishers of coastal Winneba, Ghana

Johnson Ankrah

Department of Geography Education, Faculty of Social Science Education, University of Education, Winneba, Ghana

1. Introduction

The coast has long provided its communities with several sources of livelihoods. Due to the rich opportunities associated with the coastal zones, it has attracted majority of the population of many countries (Watson et al., 1996). Livelihood opportunities from the coast ranges from employment in the form fish harvesting and fishing, food, beaches and dunes which serves as a major sources of construction aggregate, habitat for sea turtles, educational opportunities and landing sites for fishers and their canoes (Lorde et al., 2011). The wetlands found along these coasts also provide varied services for inhabitants; maintenance of atmospheric composition, habitats for migratory bird species and breeding grounds for some fish species (Basset and Abbiati, 2004). Wetlands again aid in reduction of the intensity and frequency of floodwaters. Thus wetlands act as natural buffers which soak up and stores floodwater (Kjerfve, 1994). The livelihood choices to coastal opportunities are dependent on several factors. These factors includes; social, economic, historical and educational backgrounds.

Despite the numerous livelihoods opportunities coastal inhabitants enjoy from the coast, the incidence of climate change has impacted negatively on these opportunities and has threatened coastal livelihoods. Globally, over half a billion of the population depends on fisheries for their survival (F. Fisheries, 2010). Climate change can impact fisheries in a diverse ways. The changes that occur in coastal water temperatures, precipitation and other oceanographic elements such as wave action, wind velocity and sea level rise can result to significant changes in marine ecosystems and their resident fish population (Cheung et al., 2009; Brander, 2009; Drinkwater et al., 2009). This can have adverse impacts on those whose livelihoods depend on those ecosystems. Developing countries depend on small-scale fishing due to the incidence of climate change impacts such as floods, coastal erosion, sea level rise and temperature and rainfall fluctuations (IPCC, 2007). Fish populations are under threat due to rising temperatures, changes in rainfall patterns, sea level rise and changes in dissolved oxygen concentration (Drinkwater et al., 2009). Small-scale fishing communities whose livelihoods are dependent on fishing have become susceptible to the impacts of climate change (IPCC, 2007). Globally, coastal waters have warmed. The warming of these waters is likely to continue to

about 4–8°F in the 21st Century (USGCRP, 2009; USGCRP, 2014; IPCC, 2014).

In Ghana, climate change has added to the already existing environmental problems such as land degradation and desertification (Neville and Mohammed, 2010). Ghana's climate has in recent times become drier and unpredictable. This has a great impact on the various sectors of the economy. The fishing sector and coastal communities however stand a greater risk to these impacts. These are in line with a study by Owusu and Wayhen which reveals that coastal communities of Ghana are under threat of climate change (Owusu and Waylen, 2012). These changes have serious physical, economic and social impacts on the lives of people especially those found in the coastal zones whose source of livelihood depends on the usage of natural resources (ICIMOD, 2009). Many studies in Ghana on fishers' livelihoods have been conducted however; many of these studies have been conducted on the coastal communities found in the Accra and Sekondi-Takoradi coasts (Nunoo et al., 2015; Asiedu and Nunoo, 2013). Also, in the Central Region most of these studies have been conducted on the communities along the Cape coast and Elmina coasts (Aheto et al., 2012; Effah, 2015). However, little or no studies on coastal livelihoods have been conducted on the communities of the Winneba coast.

The study assessed climate change impacts on coastal livelihoods. The study was conducted in the Winneba (Effutu) Municipality. Winneba is found 56 km (35miles) west of Accra, the capital city of Ghana and 140 km (90miles) of Cape coast. The area lies within latitude 5° 20' N and longitude 0° 37' W along the Gulf of Guinea. Winneba has a total population of about 60,331 (World Gazetteer online). Fig. 1 is the map of the study area. Winneba is found in the dry equatorial climatic zone of Ghana. There is disparity in the amount and seasonal distribution of rainfall. Winneba has two rainy seasons. The major season is found between April and July and the minor between September and November. Transportation of sediments to the coast and to the sea is high during the rainy season when the average minimum daily temperature is below 13 °C. It however, reduces during the dry season when average maximum daily temperature is over 32 °C (Meoweather, 2013). The area has a relatively low lying area with the highest point being about 150 m above sea level. The area is associated with coastal scrub and grassland with few isolated patches of trees (Dadson, 2012). Traditionally, Winneba is known as Simpa. It is a historic fishing port

E-mail address: ankrah.johnson1992@yahoo.com.

<https://doi.org/10.1016/j.ocecoaman.2018.04.029>

Received 8 October 2017; Received in revised form 28 April 2018; Accepted 30 April 2018

Available online 10 May 2018

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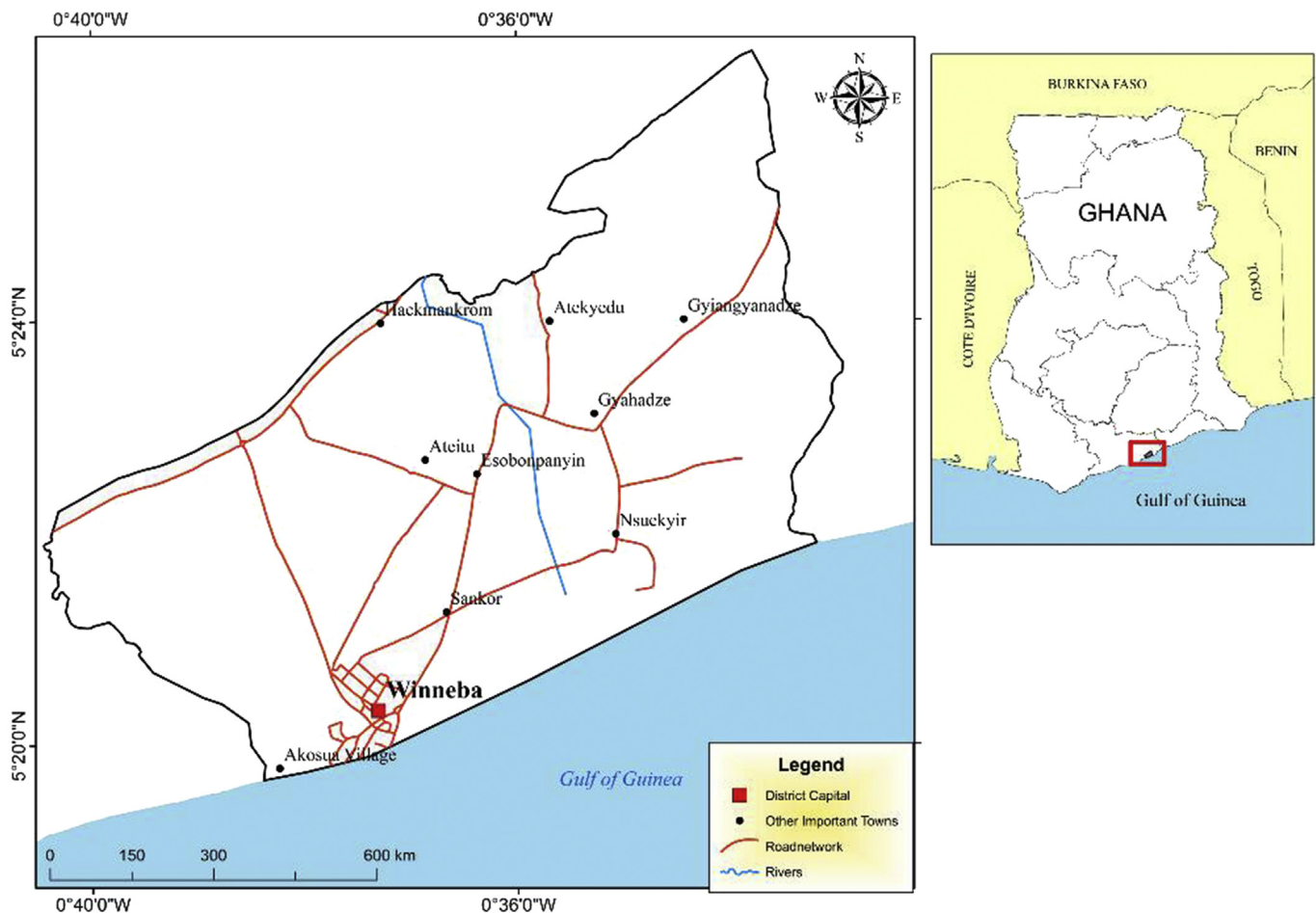


Fig. 1. Map of Effutu Municipality showing Winneba. Source: Cartography and GIS Laboratory of the University of Education, Winneba, 2017.

situated in the southern part of the country. A greater percentage of the inhabitants in the community are economically active. In terms of occupation, majority of the inhabitants are employed in the service followed by fishing. This makes fishing the major primary activity of the community. Many of the inhabitants in the Winneba Municipality depend on fishing as their source of livelihoods. The study sought to understand the knowledge and awareness level of inhabitants, their current perception and impacts of climate change on the lives of inhabitants.

2. Methodology

The study employed both primary and secondary data sources. Primary data were obtained from questionnaire administration and interviews. An annual mean temperature timeseries data from 1980 to 2016 was obtained from the Ghana Meteorological Agency (GMet).

This is a case study and falls under the descriptive research design. Both qualitative and quantitative approaches were used. 100 semi-structured questionnaires and 4 interviews were employed for the study. A total of 104 inhabitants were sampled for the study. The paper places more emphasis on the physical component of the study. The study used the viewpoints of the sample that was employed to supplement the available historical climatic data. The total population of the Winneba is about 60,331 (World Gazetteer online), a sample size of 100 as employed for the study was small and may not represent the community. However, generalization can be made. A simple sample selection technique was used to select respondents for the questionnaire administration. Results from the survey were quantified. Participants for the questionnaire administration were randomly selected based on

the following criteria; lived in the area for 5–22 years, have knowledge about climatic/weather conditions of the area and age ≥ 19 years. For the interview, one has to be a native of the study community, lived in the area ≥ 36 years and have the fishing activity as their main source of livelihood. These participants included 2 native leaders of a fisher group, a native fish seller and a fish monger. They were interviewed because they are found along the coast and have fishing as their main source of livelihood. The special factor that differentiated the questionnaire administration from the interview was the length of stay in the study community and where respondents come from. Data from the questionnaire administration was analysed by the use of Statistical Package for Social Sciences (SPSS v.16.0). This helped in generating frequency tables. Questions that were raised in the interview included how participants safeguard their fishing activity from the impacts of climate change and the measures they put in place to cope with the impact climate change.

The interview was conducted between an interviewer and a participant and it was conducted at a place where the participant was engaged, specifically, the participant home. At the instance where participants were at their duties at their work place (Shore), the interview was conducted at point where the participant was free and devoid of any third party. The interview was conducted in the local dialect (Effutu). For anonymity sake, no names were assigned to the interviewee and did not include any personal traits. Questions relating to participants' perspectives on climate change were asked. Specific question included how they safeguard their fishing activity from the impacts of climate change and the measures put in place to cope with the impact climate change. The interviews from this study were tape recorded if and only when the interviewer and the participant agreed.

This helped in the transcription stage of the interview as participants' responses were captured in their own words. The participants' personal views from the interviews conducted in April 2017 were presented in quotations.

3. Results and discussions

The results constitute the general understandings of the sample that was employed for the study. The standpoints of the respondents on the impacts of climate change on coastal livelihoods in the community are the raised categories from the data. The report of the administered questionnaires and interviews are grouped into three themes: Livelihood conditions of fishers, impacts of climate change on fisher livelihoods and coping and adaptation strategies of fishers to the impacts of climate change. The subjective standpoints of the respondents were however augmented with physical climatological data.

3.1. Background information of respondents

A seemingly majority of the respondents 43 were aged between 31 and 40years as at the time of the survey. The Effutu Municipality is dominated with females (51%) (GSS, 2014). The number of males who participated in the survey was greater than females. This is basically attributed to the economic activity in question. Fishing as economic activity in the community is dominated by males. On the marital status of the respondents, majority of them were married men and women with few being single. Concerning their occupation, majority of the respondents sampled were fishermen, followed by fish sellers with few being fish mongers. Also, on the education of the respondents, majority of them had attained primary/Junior Secondary School (JSS) level as at the time of the survey, followed by no formal education and few attaining Senior Secondary School (SSS) education. It was surprising that none of the sampled employed had attained tertiary education. This signifies that the primary economic activities and fishing in particular in the community are dominated by people with low educational attainments. Again, of the sample employed, majority of them have lived in the community for about 17–22years as presented in Table 1.

Table 1
Background information of Respondents.
Source: Field survey, 2017.

	Frequency
Age	
20–30years	34
31–41years	43
42–52years and above	23
Total	100
Sex	
Male	65
Female	35
Marital status	
Married	69
Single	31
Occupation	
Fisherman	65
Fish seller	26
Fish monger	9
Total	100
Education	
Primary/Junior Secondary School	93
Secondary	3
No formal education	4
Total	100
Length of stay in community	
5–10years	15
11–16years	25
17–22years and above	60
Total	100

Table 2
Livelihood conditions of Fishers.
Source: Field survey, 2017.

	Frequency
Alternative sources of income	
Yes	30
No	70
Total	100
Number of Child/children	
1	9
2	36
3	29
4	4
No child	22
Total	100
Other dependents	
Yes	100
Satisfaction of income earned from fish business	
Yes	20
No	80
Total	100
Ownership of house	
Yes	29
No	71

3.2. Livelihood conditions of fishers

From Table 2, it can be seen that majority of the respondents do not have any alternative sources of income. They however depend on the fishing activity for their livelihoods. Others engage in farming and livestock rearing aside fishing. The farming activities however, due to the climatic region of the area (dry-equatorial) which is associated with low rainfall and poor soils does not support the growth of cash crops such as cocoa and cashew. Respondents therefore practice peasant farming system to support their families. This turns to lower their economic livelihoods. Majority of the respondents have at least 1 child with few having no child. The number of birth of the respondents is a reflection of the fertility rate of the Effutu Municipality (GSS, 2014). The study again found that aside the child/children that respondents takes care of, they also have other dependents. These dependents are relatives from the extended family and friends. Family lineage and inheritance system in Ghana and in the Effutu Municipality in particular plays dwindling role on the livelihoods of people. A seemingly majority of the respondents are not satisfied with incomes they earn from the fishing activity. The lamentations of the fishers on their dissatisfaction of incomes earned are attributed to the pressures from the other dependents. A greater proportion of the respondents are not owners of the houses they live in while few declared full ownership of their. Field observation revealed that participants with house ownerships use less quality materials such as bricks and mud and roofed mostly with slate/asbestos, bamboo and few with metal sheets. Respondents attributed the usage of less quality materials to the salty moisturised water that mixes with air and corrode buildings. The study however, attributed this to the low social and economic livelihood of the fishers.

3.3. Impacts of climate change on fishers livelihoods

There was a consensus (100%) among the respondents about climate change awareness. The respondents (100%) agreed that the study community is under threat of climate change and its impacts. The respondents however indicated the impacts of climate change on their livelihoods as presented in Table 3.

The study found varied responses from respondents on the most visible impacts of climate change in the community. Majority of the respondents complained about rising temperature. These are widely a view shared by many of the fish sellers and fish mongers. They sell under the sun and the rays of the sun fall on them directly. For instance,

Table 3
Impacts of climate change on fishers livelihoods.
Source: Field survey, 2017.

	Frequency
Most visible impacts of climate change in the community	
Coastal erosion	22
Rising temperature	27
Sea level rise	21
Decreasing rainfall levels	24
Other	6
Total	100
Climate change impacts on fish population and fish catch	
Yes	100
Total	100
How climate change has impacted fish population and fish catch	
Decreasing fish population and the amount of fish catch	90
Other	10
Total	100
How climate change impacts economic and social livelihoods of fishers	
Low income earned	55
Inability to secure loans from banks due to low savings	25
Poverty	20
Total	100

the sun's intensity becomes high in the month of March and April and the community could record a maximum temperature of about 30 °C. Decreasing rainfall levels in the community were again found to be the second most pressing impact. Generally, the study community lies in the dry equatorial climatic region which is characterized by low rainfall and long dry season of five months (Dadson, 2012; GSS, 2014). This climatic region records an annual rainfall amount of about 400 mm–500 mm. The highest rainfall is recorded in the month of June and lowest in January. The climate change incidence in the community has however changed the amount and pattern of rainfall in the community. Informal conversations with respondents revealed that in the early and later part of the 1990s, the community received heavy rains during the month of June. They further reported that this is not the case in the present days. This notwithstanding, the greater impacts of climate change such as coastal erosion, sea level rise and others such as flooding in the community cannot be ignored.

The fishermen lamented about the advancement of the sea towards the land. Field observations revealed that there is an incidence of coastal erosion in the community and the sea has also risen. The beach has two faces one rocky and the other sandy. The rock resists the tidal waves and this prevents the sea from eroding the land. The sandy side on the other hand, lacks the ability to resist the waves. The sand sometimes soaks the sea water. However, depending on the intensity of the waves bringing the sea water towards the land, the sand cannot soak much of these waters. These waters therefore erode the land. The landing site of the fishermen is gradually approaching the land and this is due to the advancement of the sea. Informal conversations with respondents revealed that there is an evidence of sea level rise. They reported, the sea increases in volume everyday around 4:00pm. Non-natives of the community who are not good at swimming are always driven out during occasions and holidays. The respondents further indicated that some years ago, the sea increased in volume and extended to the land and flooded many places. The respondents therefore believe the sea would one day take their position.

The respondents (100%) agreed that climate change has impacts on fish population and fish catch. They indicated that climate change impacts in the community have decreased fish population and the amount of fish catch. The emission of greenhouse gases through climate change has caused the Earth's atmospheric temperatures to increase. As the Earth's atmospheric temperature rises, the ocean absorbs these heat and becomes warmer (IPCC, 2007). The warming of the ocean however,

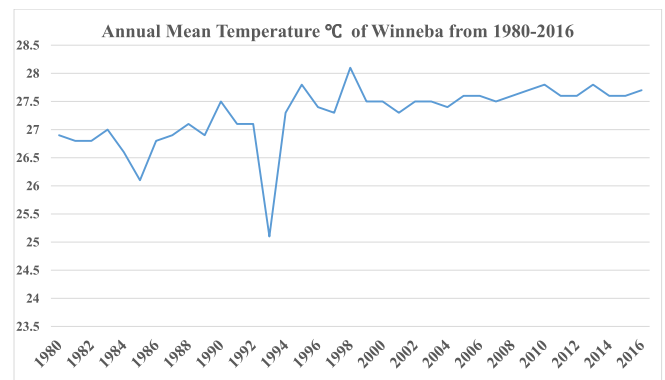


Fig. 2. Annual mean temperature of Winneba from 1980 to 2016. Source: Ghana Meteorological agency (GMet).

shifts the ideal water temperature and fish population decreases or move to other areas. Fishes change their body temperature by the help water temperature so an increase in sea water temperature can impact negatively on the growth and reproduction fish species. The incidence of sea level rise will also cover wetlands and other low lying areas where fish reproduce. This has a great impact on important fish species. The study again found that climate change has great impact on the economic and social livelihoods of fishers. This ranged from low incomes earned, inability to secure loans from banks due to low savings and poverty. These economic and social impacts indicated by the respondents are influenced by many factors such as seasonality of fish and low quality of fish catch resulting in poor sales. Financial institutions give loans to people who have businesses and engage in transactions with them. The above mentioned economic and social factors deter financial institutions from giving loans to fishers. Though these people are economically engaged, they however have poor livelihoods. As indicated in the methodology, the study supplemented the subjective views on the respondents with available historical climatic data. An annual mean temperature timeseries data of the community from 1980 to 2016 were used as presented on Fig. 2.

From Fig. 2, it can be seen that there has been changes in the temperature levels of the community for the past 36 years. Analysis from the data reveals that with the exception of the base year, temperatures have been increasing though there were significant decreases in the years of 1985 and 1993. For decade's comparison, it can be seen that temperatures were high in the 1990's followed by 2000's and the 1980's. Averagely, the community's temperature has been increasing though on a decreasing rate. From a critical look at the data, it can be seen that changes in means over the wet and dry season are small. It can also be seen that, the community's temperature has started rising from the beginning of the third decade. Though temperatures are rising at a slower rate, it can have a great impact on the both human lives and on the coastal environment. Rising temperatures in coastal zones increase temperatures of ocean waters which harm fish growth and reproduction. It also disrupts the daily activities of the inhabitants. The physical data therefore supports the subjective views of the respondents.

3.4. Coping and adaptation strategies to the impacts of climate change

From Table 4, it can be seen that the adaptation strategies adopted by the respondents differs. Majority of the respondents as a way of adapting to the impacts of climate change improve the technologies they employed in fishing while others find different jobs during lean season. Few of them also move to other fishing communities. Improved technology here means respondents change from their traditional canoes usage to the use of outboard motors. This helps them to get more

Table 4

How respondents cope with and adapt to the impacts of climate change.
Source: Field survey, 2017.

	Frequency
How do you safeguard your fishing activity from the impacts of climate change	
Improved technologies	51
Move to other fishing communities	18
Find other job during the lean season	31
Total	100
Measures put in place to cope with climate change impacts	
Put more effort into fishing	55
Saves money	36
Other	9
Total	100

fish. Those that depend on season relocate to other fishing grounds and those that find other jobs during the lean season either work on their own small farms, rear animals or finds mason/construction work.

In an interview with participants on this issue, they reported as expressed in the statements below:

Due to the seasonality of fish catch, we have planned to buy an outboard motor. This will save as from the manual paddle and we can go deep into the sea to get more fish. 42year old leader of a fishing group. Field interview, 2017.

Nowadays, the fishermen do not get enough fish from the sea. They however sell the few they get to us at higher prices. I do not depend solely on the fishermen in this community. I have customers at other fishing communities. I have a big refrigerator in the house where I store fish. When I get enough fish, I send them to the market for sale. 37year old seller. Field interview, 2017.

The study also found that respondents have devised some coping strategies against climate change impacts. Majority of the respondents put more effort into fishing while save money. In an interview with participants on this issue, they indicated as expressed in the statement below:

We do not get enough fish during the dry season. Temperature becomes hot during this period. We however, put more effort in fishing when it starts raining normally during the month of July and August. We only rest on Tuesday and Sunday. Tuesdays we do not fish because it is a taboo and we go to church on Sunday. 54year old leader of a fishing group. Field interview, 2017.

I smoke all the fish I get from the fishermen. I smoke them because; I take them to long places to sell. I do this to prevent them from going bad in order to keep my profit so that I can save some. 38year old fish monger. Field interview, 2017.

4. Conclusions

The study assessed the impacts of climate change on the livelihoods of the fishers in Winneba. The study revealed that majority of the fishers in Winneba do not have alternative source of income. They have fishing as their main occupation. The study again revealed that aside the number of children of fishers; they also have other dependents that they take care of. This has resulted to their dissatisfaction of the incomes they earn. The study further revealed that respondents are aware of the issue of climate change and agreed to its impacts in their community. However, respondents lack detailed understanding of the climate change issue. Awareness about potential answers is the first step in the climate change risk adaptation measures and the basic condition for the development of an adequate adaptive capacity. In order to design, device, and respond promptly to adaptation measures, awareness must be equally embedded in experts of the socioeconomic and scientific disciplines, in government agencies, and in the community at large.

Awareness in this context may include; awareness on climate change impacts in the community, awareness of how these impacts affect coastal areas, the changes brought and how the community responds. Although majority of the respondents attributed the most visible impact to rising temperature and decreasing rainfall as supplemented by physical climatological data however, the dire impacts of coastal erosion and sea level rise in the community cannot be ignored. Majority of the respondents agreed to the notion that climate change has a greater impact on fish population and the amount of fish catch. These impacts include; decreasing fish population and the amount of fish catch. The study also found that the low amount of fish catch has a greater impact on the economic and social livelihoods of respondents. They earn low incomes resulting to their inability to secure loans from banks. Although they are economically engaged, they still find themselves in poverty. The study moreover revealed that the incidence of climate change impacts in the community is a reality. Respondents however adopt different adaptation and coping strategies in the mitigation of these impacts.

Adaptation to climate change in coastal areas may include a variety of strategies from local inhabitants and policy actions from the government that addresses multiple sectors and not just fish capture. Adaptation activities may be addressing short-term or long-term impacts. Local inhabitance may adapt to climate change issue in the community by reducing external stressors on natural systems. For example, by reducing land based sources of pollution such as waste burning, habitat destruction, over fishing and destructive fishing explosives and poison which cause acidification of sea waters. Also, local inhabitants may resort to the Living Shoreline Approach (LSA) which uses sand and small rocks to protect shoreline and habitat as against sea level rise. However, due to the intensity of the waves that carry sea water, this approach may not be appropriate and may need to be replaced by hard resistant materials such as sea walls or groynes. Also as a way of adapting to the climate change issue in the community, fishers can move to new fishing grounds during periods of low fish catch under the influence climate change. The government should involve in adaptation issues that may not specifically focus on fisheries. There can be the growth of mangrove for the protection of the community from coastal erosion. Although the basic idea may not be related to fishers' livelihood, ecosystem services from the growth of mangrove will positively affect the livelihoods of the fishers. Mangroves serve as sources of habitat for aquatic organisms and this will serve as food product for fishers. Adaptation is a changing social process. The ability of a community to adapt is determined by the collective effort of the community. In coastal communities, there is the need for co-operative management. In this case, stakeholders share tasks for decision making and management of the coastal community and the aquatic resources. This can promote resilience of the community to climate change. The government should therefore make investments to support and operate the social capital of fishers in the community, which is the principal asset of the poor. This will create situations that will enable fishers to partake in adaptation policy formulation and effectively manage their resources through active involvement in realizing and monitoring regulatory measures that aims at enhancing their livelihood.

Fisheries development provides many advantages. From community to national levels, fisheries play essential role in food supply, income generation and nutrients. Fishing contributes to national food security and change of diets. This notwithstanding, the advantages from fisheries are often ignored in national economic planning. This is due to the fact that, fishing in Ghana is done on small-scale. Although the importance of fisheries abound, the consequences of climate change for this sector and for coastal communities cannot be ignored. Climate change has added up to the already existing anthropogenic pressures on fisheries such as; pollution and ecosystem degradation. Changes in biophysical features of the aquatic environment and regular occurrence of life-threatening events will have significant effects on the ecosystem that support fish. Rising coastal temperature will have a negative

impact on fish growth and production. Fish are sensitive to changes in temperature of their surrounding environment. This means that their internal temperature differs directly with that of their environment. When fish continues to encounter rising temperature, it will slow their rate of growth. There is an increase in fish population when there is availability of nutrients in water. This however, depends on the fresh water run-off and ocean mixing as well as sunlight and temperature. Reduced rainfall in the community will lead to reduced run-off from land. This will starve the community's wetland of nutrients and destroying fisheries. This will however, affect the future of small-scale fishing in the community. Fishers in the community should be helped in building their adaptive capacities in ways that will allow them to moderate possible harms, take advantage of opportunities or cope with the effects.

The study recommends a comprehensive policy approach that will take into account the detailed livelihood enhancement needs of fishers. Climate change impacts on livelihoods are increasingly becoming a problem in coastal areas. Possibly, as a first step, alternative sources of livelihoods should be available to fishers. Also, a realistic policy framework should be formulated to mitigate, adapt and cope with the impacts of climate change in coastal areas. For example, there is the need to strengthen research on climate change in order to adapt or mitigate its impacts.

Acknowledgements

I thank the three anonymous reviewers for their insightful comments on the paper.

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